

the cubital fork does not touch M_{3+4} . The third papal segment is not as swollen. The spermathecae are more equal in size to one another than in *darlingtonae*. Table 1 compares this new species with Wirth and Blanton's new *debilipalpis* group species and with the two closely related Colombian species from the Andes.

I wish to express my appreciation to Dr. Willis W. Wirth for his advice and suggestions in the preparation of this paper and to Dr. F. Eugene Wood for making the drawings. Mrs. Mary Kilbourne took the photograph (fig. 2) and gave permission to use it for which I am grateful.

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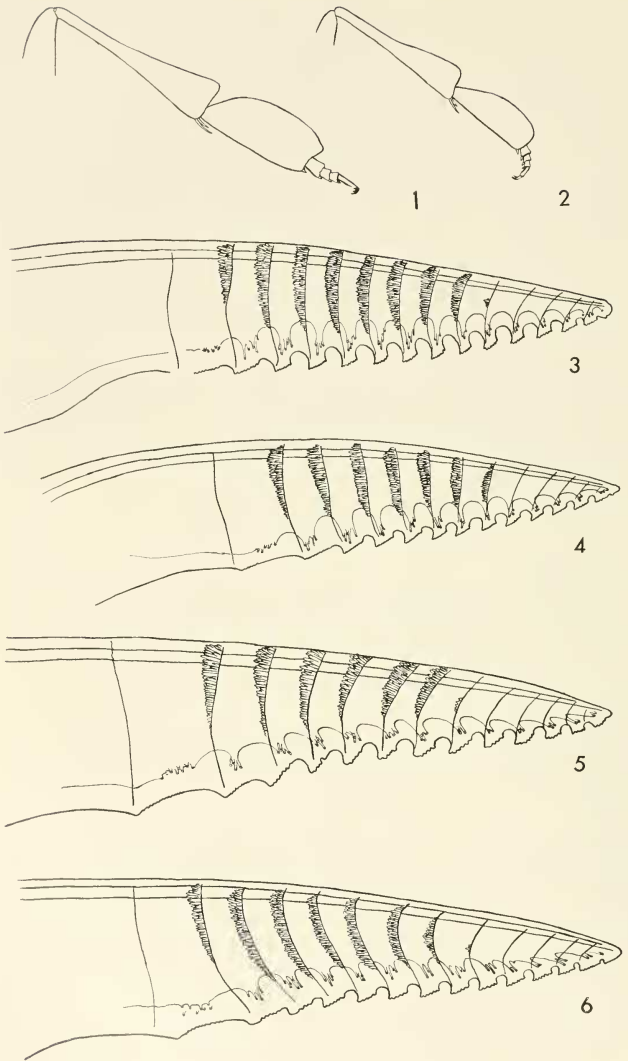
SAWFLIES OF THE GENUS *CROESUS* LEACH IN NORTH AMERICA (HYMENOPTERA: TENTHREDINIDAE)

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ABSTRACT—Adults and larvae of the four North American species of *Croesus* are keyed, described, and illustrated. One new species, *C. curvarius*, is described. The larvae are external feeders on the foliage of *Betula*, *Alnus*, *Castanea*, and *Corylus*.

The genus *Croesus* is a small group of holarctic sawflies characterized by the conspicuous, flattened hindbasitarsus and hindtarsus. Few sawflies have such an obvious spot character for separation. Larvae of *Croesus* are more commonly encountered than adults because, as in most sawflies, of their noticeable feeding habits. They feed externally on the foliage of *Betula*, *Corylus*, *Alnus*, and *Castanea* in North America, and, in Europe, other species have been found on *Acer*, *Carpinus*, *Fraxinus*, *Populus*, *Salix*, and *Sorbus* (Benson, 1958).

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The North American species have never been revised, and only three species were listed by Ross (1951). A fourth species is described here. All species are found in eastern North America, with only one, *latitarsus* Norton, ranging west to Utah, British Columbia, and Alaska. Another species, *varus* (Villaret), is known only from a single specimen taken at Montreal, Quebec in 1926. This European species may have been introduced, but its establishment on this continent is open to question.

Croesus Leach

Croesus Leach, 1817, Zool. Misc., Vol. 3, p. 129; Morice, 1906, Ent. Mon. Mag. 42:32; Rohwer, 1911, U.S. Bur. Ent. Tech. Ser. 20, p. 99; Enslin, 1915, Die Tenthredinoidea Mitteleuropas, Beit. Deut. Ent. Ztschr., p. 364; MacGillivray, 1916, Conn. Geol. Nat. Hist. Surv. Bull. 22, p. 121; Yuasa, 1922, Ill. Biol. Monog. 7, p. 83; Malaise, 1932, Arkiv. för Zool. 23:36; Ross, 1937, Ill. Biol. Monog. 34, p. 78; Ross, 1951, U.S. Dept. Agr., Agr. Monog. 2, p. 42; Takeuchi, 1952, A Generic Classification of the Japanese Tenthredinidae, p. 68; Wong, 1951, Ent. Soc. Ontario, 82nd Ann. Rept., p. 65; Lorenz and Kraus, 1957, Die Larvalsystematik der Blattwespen, p. 217; Benson, 1958, Handbooks for the Identification of British Insects, Vol. 6, pt. 2(c), p. 209; Benson, 1963, Ent. Tidskr. 84:18. Type-species.—*Tenthredo septentrionalis* Linnaeus. Monotypic.

The greatly expanded and laterally compressed hindbasitarsus and apex of the hindtibia (fig. 1, 2) will readily distinguish this genus from all other genera of Nematinae. The wing venation is typical of the Nematinae, with cross-vein 2r and the basal anal cell both absent in the forewing. The emarginate clypeus, bifid tarsal claw, and, in side view, the angulate frontal crest of the head are additional characters. The species of *Croesus* are very close to some species of *Nematus*, especially those placed in the *Erythrogaster* Group by Ross (1951), in general habitus of the genitalia of both sexes. The distinctive hindlegs of species of *Croesus*, however, may be used to separate *Croesus* and *Nematus* and to retain them as separate genera. Such an obvious character is welcome in a group where there are so few evident external features.

The larvae of *Croesus* species are typical of the Nematinae in having prolegs on abdominal segments 2 to 7 and 10 only and with an eversible gland on the venter of abdominal segments 1 to 7. The following combination of characters will help to separate the larvae from those of other Nematinae: (1) Tenth abdominal tergum with a pair of short caudal protuberances (fig. 14); (2) conical antennae; (3) spiracles not winged; (4) abdominal segments 2 to 9 each with 6 annulets, annulets 2 and 4 setiferous; (5) either with a transverse black stripe or

←
Figs. 1–2. Hindtibia and hindtarsus: 1, *Croesus latitarsus* Norton; 2, *C. curvarius*, n. sp. Figs. 3–6. Lancets: 3, *C. castaneae* Roh.; 4, *C. latitarsus*; 5, *C. curvarius*; 6, *C. varus* (Vill.).

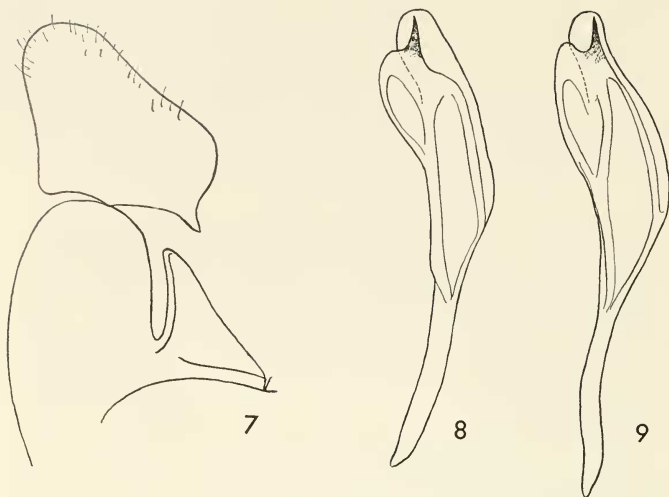


Fig. 7. Harpe and parapenis, *Croesus latitarsus* Norton. Figs. 8-9. Penis valves: 8, *C. latitarsus*; 9, *C. castaneae* Roh.

with not more than 3 black spots on each side of each segment of the body (figs. 15-16)²; and (6) free leaf feeders, as opposed to the gall forming Nematinae. The epipharynx, maxilla, and mandibles are as in figures 10 to 13 and are similar for each species.

About 13 world species are included in *Croesus*, four of which are found in North America. Benson (1963) gave a key to the world species or species complexes.

KEY TO SPECIES
Adults

- | | |
|---|-------------------------|
| 1. Female | 2 |
| Male | 5 |
| 2. Abdomen with red band; each femur orange [mesopleuron shining, with well-defined, separated punctures] | <i>varus</i> (Villaret) |
| Abdomen and each femur black | 3 |

²Specimens of a *Croesus* species reared from *Betula* in Virginia by Harold Greenbaum of the University of Florida differ from the species described here: The larva has a broad, dorsal, longitudinal black stripe running the length of the body and extending laterally to the spiracles, and the male has the abdomen and each hindfemur entirely black. The texture of the mesopleuron is apparently similar to that of *latitarsus*. According to Mr. Greenbaum, this may represent a distinct species.

- | | |
|--|--------------------------|
| 3. Annuli 2 to 8 of lancet markedly curved backward toward dorsal margin (fig. 5) [mesopleuron roughened but shining, without well-defined, separated punctures; apex of hindbasitarsus straight (fig. 2)] ... <i>curvarius</i> , n. sp.
Annuli 2 to 8 of lancet nearly straight (figs. 3, 4) | 4 |
| 4. Mesopleuron roughened, dull, not shining or with distinct punctures; hindbasitarsus with slight lobe at apex (fig. 1); lancet with lateral armature on annuli 2 to 8 and with serrulae as deep as broad (fig. 4) | |
| | <i>latitarsus</i> Norton |
| Mesopleuron shining, with well-defined, separated punctures; hindbasitarsus straight at apex (fig. 2); lancet with lateral armature on annuli 2 to 9 and with serrulae deeper than broad (fig. 3) | <i>castaneae</i> Rohwer |
| 5. Abdomen and hindfemur black ² | <i>castaneae</i> Rohwer |
| Abdomen red-banded; hindfemur orange | 6 |
| 6. Mesopleuron roughened, dull, without well-defined punctures | |
| | <i>latitarsus</i> Norton |
| Mesopleuron shining, with well-defined, separated punctures ... | <i>varus</i> (Villaret) |

Larvae

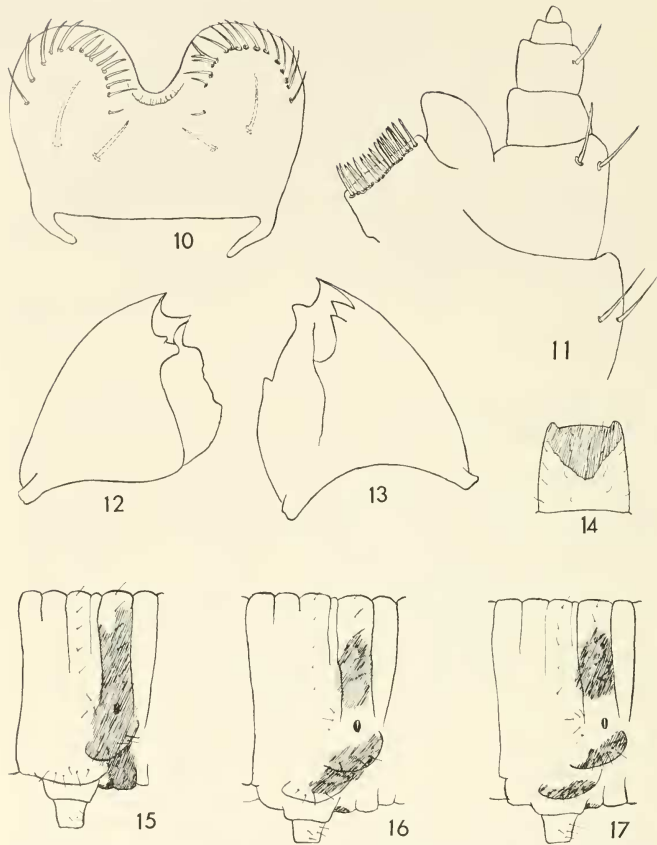
- | | |
|---|---------------------------|
| 1. An unbroken black stripe on each side of each body segment except for prothorax and tenth abdominal segment (fig. 15), stripe continuous on venter of each segment; tenth tergum without black spots; on <i>Castanea</i> | <i>castaneae</i> Rohwer |
| Body segments each with 2 or 3 dark brown spots on each side (figs. 16, 17); tenth tergum partly dark brown ² | 2 |
| 2. Each body segment with one supraspiracular and one subspiracular dark brown spot, each equal in size (fig. 16); band on anterior margin of tenth tergum dark brown; on <i>Corylus</i> | <i>curvarius</i> , n. sp. |
| Each body segment with one supraspiracular and two subspiracular dark brown spots, the supraspiracular spot larger than the others (fig. 17); apex of tenth tergum dark brown (fig. 14) | 3 |
| 3. Head black; on <i>Betula</i> | <i>latitarsus</i> Norton |
| Head reddish-brown or reddish-yellow; on <i>Alnus</i> | <i>varus</i> (Villaret) |

Croesus castaneae Rohwer

Croesus castaneae Rohwer, 1915, Proc. U.S. Nat. Mus. 49:213, ♂, ♀; Middleton, 1922, Proc. U.S. Nat. Mus. 61:14; Ross, 1951, U.S. Dept. Agr., Agr. Monog. 2, p. 42.

Female.—Average length, 9.5 mm. Black, apex of clypeus, apex of labrum, apex of hindcoxa, basal one-third of each tibia, and all of front and middle basitarsi whitish. Wings very lightly and uniformly infuscated.

Postocellar area one and one-half times broader than long. Mesopleuron shining, with fine, well-defined punctures, punctures separated from each other by smooth, shining interspaces; mesosternum smooth and shining, without punctures. Apex of hindbasitarsus straight (fig. 2). Sheath short, straight above, rounded below. Lancet with about 15 serrulae, each serrula deep, separated from each other by deep circular notch deeper than breadth of a serrula; 5 or 6 fine subbasal teeth on ventral margin of each serrula; lateral armature present on annuli 2 to 9, these annuli being nearly straight (fig. 3).



Figs. 10-14. *Croesus latitarsus* Norton, larval structures: 10, epipharynx; 11, maxilla; 12, right mandible; 13, left mandible; 14, tenth abdominal tergum, dorsal view. Figs. 15-17. Third abdominal segment of larvae, lateral view: 15, *C. castanecae* Roh.; 16, *C. curvarius*, n. sp.; 17, *C. latitarsus*.

Male.—Average length, 7.0 mm. Color similar to that of female, except for front and middle tibiae and tarsi which are entirely whitish. Structure similar to that of female. Lateral spine of penis valve with accompanying lobe (fig. 9); harpe and parapenis as in fig. 7.

Holotype.—*C. castaneae* Rohwer is U.S.N.M. type no. 18522, ♀, labeled "Falls Church, Va., reared, Sept. 16, 1912, *Castanea dentata*, Hopk. 10154."

Distribution.—Eastern North America. KENTUCKY: Baldrock, Sept. 23, 1959, on American chestnut (larvae). MARYLAND: Plummers Id., VIII-8-14. NEW YORK: "N.Y." PENNSYLVANIA: Inglebrook, Dauphin Co., IX-12-09. VIRGINIA: Falls Church, reared, Sept. 16, 1912, *Castanea dentata*; Rocky Mount, July 10, 1961, on chestnut (larvae).

Host and Biology.—Adults were bred from larvae feeding on chestnut, *Castanea dentata* (Marsh.) Borkh. Larvae of the type series were collected August 7, 1912 and placed in rearing. They fed gregariously on the edge of the leaves. By August 17, all larvae had gone into the ground. Six adults emerged on September 16, 1912.

Larva.—Middleton (1922) described the larva of this species. It is easily distinguished from larvae of other species of *Croesus* by the continuous vertical, dark-brown stripe on each side of each segment of the body (fig. 15), and the lack of dark areas on the tenth tergum.

Discussion.—This shining mesopleuron of both sexes and black abdomen of the male will separate *castaneae* from *latitarsus*, and the black abdomen of the female will separate it from *varus*. *C. castaneae* most closely resembles *curvarius*, and the distinction between the two is discussed under that species.

Croesus curvarius, n. sp.

Female.—Average length, 8.2 mm. Antenna and head black; labrum brownish; white spot on each anterolateral margin of clypeus. Thorax black. Front and middle legs with each coxa, femur, and apical half of tibia black, trochanter and basal half of tibia white, tarsus whitish, infuscated toward apex; hindleg with basal half of coxa black, apical half white, trochanter white, femur black, basal half of tibia white and apical half black, tarsus black. Abdomen black. Wings uniformly, very lightly infuscated.

Postocellar area twice as broad as long. Mesopleuron shining, although roughened and without well-defined punctures; mesosternum shining, with widely spaced punctures. Hindleg as in fig. 2; basitarsus straight below, without small lobe as in *latitarsus* (fig. 1). Lancet with 13 segments, annuli beyond second sharply bent backward dorsally; lateral armature present on segments 2 to 7; serrulae deep, central and apical serrulae with no anterior and 3 to 6 coarse posterior subbasal teeth (fig. 5).

Male.—Unknown.

Holotype.—Female, labeled "Corylus," "Putnam, Conn., VII-31-42," "N.E. For. Ins. Lab. 364 205 41 12." U.S.N.M. type no. 71204.

Paratypes.—CONNECTICUT: same data as for holotype (4 ♀♀); data as for holotype except for dates, VII-42 (3 ♀♀), VIII-1-42 (1 ♀), VIII-7-42 (1 ♀), VIII-11-42 (2 ♀♀); Oneco, bred specimen, 7-18-21,

hazelnut, Gip. Moth Lab. 12164F126 (2 ♀♀). Deposited in the U.S. National Museum and the Northeastern Forest Insect and Disease Laboratory, Hamden, Connecticut.

Larva.—The larva may be distinguished from those of other North American species of *Croesus* by the presence of two large subequal dark brown spots on each side of each body segment (fig. 16) and the dark brown band on the anterior margin of the tenth tergum. Also, there is a dark spot between the prolegs on each abdominal segment.

Host.—Adults were bred from larvae feeding on *Corylus* sp.

Discussion.—The lancet with annuli 2 to 9 markedly curved posteriorly toward the dorsal margin is distinctive for this species. The mesopleuron is roughened and without well-defined, separated punctures similar to the mesopleuron of *latitarsus*, but it is shining in *curvarius* and not dull as in *latitarsus*. The mesopleuron of *castaneae* is also shiny, but there are well-defined punctures separated by smooth, shining interspaces.

Croesus latitarsus Norton

Tenthredo septentrionalis Harris, nec Linnaeus, 1834, *In Hitchcock, Rpt. on Geol., Mineral., Bot., and Zool. of Mass.*, p. 583

Craesus [!] *latitarsus* Norton, 1862, *Proc. Ent. Soc. Phila.* 1:199, ♀; Norton, 1867, *Trans. Amer. Ent. Soc.* 1:84; Provancher, 1883, *Petite faune Entomologique de Canada*, Vol. 2, Hyménoptères, p. 740; Jack, 1888, *Psyche* 5:41; Dyar, 1893, *Can. Ent.* 25:246; Dyar, 1895, *Can. Ent.* 27:342; Konow, 1905, *Genera Insectorum*, fasc. 29, p. 61 (*latitarsis*); MacGillivray, 1916, *Conn. Geol. Nat. Hist. Surv. Bul.* 22, p. 121; Yuasa, 1922, *Ill. Biol. Monog.* 7, p. 83; Brown, 1940, *Canada Dept. Agr. Forest Insect Surv.*, 4th Ann. Rpt., p. 16; Ross, 1951, *U.S. Dept. Agr., Agr. Monog.* 2, p. 42; Wong, 1954, *Can. Ent.* 86:154; Maxwell, 1955, *Can. Ent.* 87, Sup. 1, p. 69; Raizenne, 1957, *Canada Dept. Agr. Pub.* 1009, p. 33.

Nematus latitarsus: Dalla Torre, 1894, *Catalogus Hymenoptorum*, Vol. 1, p. 223 (*latitarsis*).

Female.—Average length, 9.3 mm. Black; labrum brownish; apex of hindcoxa, hindtrochanter entirely, basal one-third of hindtibia, basal one-half of front and middle tibiae, and basal one-half of front and middle basitarsi whitish. Wings hyaline with very faint infuscated band below stigma.

Postocellar area nearly twice as broad as long. Mesopleuron dull, roughened, without well-defined punctures; mesosternum shining with scattered punctures. Apex of hindbasitarsus with slight lobe (fig. 1). Sheath short, straight above, rounded below. Lancet with about 13 serrulae, each serrula deep, circular notch separating each serrula about as deep as breadth of a serrula; 5 or 6 fine subbasal teeth on apical slanted margin of each serrula; lateral armature present on annuli 2 to 8, these annuli nearly straight (fig. 4).

Male.—Average length, 7.0 mm. Antenna black, occasionally dark orange; head black, sometimes supraclypeal area, clypeus, and labrum whitish. Each coxa black with apex of hindcoxa whitish; each femur orange; front and middle tibiae

orange, hindtibia with basal half orange, apical half black; front and middle tarsi orange, hindtarsus black. Abdomen orange with first two segments black; hypandrium sometimes infuscated. Structure similar to that of female. Lateral spine of penis valve without accompanying lobe (fig. 8). Harpe and parapenis as in fig. 7.

Type.—There are two specimens, one of each sex, in the Museum of Comparative Zoology, Harvard University labeled "179 ♂" and "179 ♀," "MCZ Type 26326." There is also a specimen in the Academy of Natural Sciences of Philadelphia, a female labeled "Pa." and "Type 10304." Norton (1862) described only the female and stated "Pennsylvania (Coll. Ent. Soc. Phil.), Mass. (Harris Coll.)." All three specimens at Harvard and Philadelphia are the same species; however, I am designating the specimen at Philadelphia as the lectotype.

Distribution.—Eastern North America, Quebec to Florida west to Utah, British Columbia and Alaska. ALASKA: Matanuska, VI-44. BRITISH COLUMBIA: Carbonate, Columbia R., July 7-12, 1908, 2600'. CONNECTICUT: East River, reared, many dates from April to October of various years from *Betula populifolia*, *Betula populifolia-nigra*, *Betula lenta*; Lyme, VI-18-18. FLORIDA: Alachua Co., VI-1954. ILLINOIS: Antioch, Aug. 1, 1960; Herod, June 6, 1946; Urbana, May 9, 1935. MAINE: Augusta, emergence dates in June and August, ex gray birch; Bar Harbor, bred, June 1, 4, 1934, on gray birch; Mt. Desert I., bred, VIII-17, 18-1932, gray birch; Greenville, VI-1-32; Auburn, July 29, 1968; Orono, June 12, 1907. MANITOBA: recorded by Wong (1954). MASSACHUSETTS: Chelmsford, 20-8-29, *Betula populifolia*; Lynnfield, V-11-18, *Betula populifolia*; Newton, 1938; Southbridge. MICHIGAN: Cheboygan Co., 8-2-1934. MINNESOTA: St. Anthony Park, 7-24-91; Eaglesnest, Aug. 8, 1957. MISSOURI: Columbia, August 10, 1904. NEW HAMPSHIRE: Durham. NEW YORK: Cranberry Lake, 8-8-25; Big Indian Valley, Catskill Mts., V-23-06; Orient Pt., Sept. 8, 1917; Ringwood, May 23, 1937. NORTH CAROLINA: Davidson Co., May 22, 1958, on birch (larvae). NOVA SCOTIA: recorded by Brown (1940) from Cape Breton I. ONTARIO: recorded by Raizenne, (1957). PENNSYLVANIA: Marysville, VII-14-12. QUÉBEC: Cascapedia R., VII-10-1935, white birch. SASKATCHEWAN: recorded by Wong (1954). UTAH: Logan, August 16, 1950. VERMONT: W. Topsham, Waits River, June 21, 1941. VIRGINIA: Strong Man Mt., July 31, 1900 (H. G. Dyar "11C"). WISCONSIN: Cranmoor, VI-9-10.

Larva.—The larva was described by Dyar (1893) and Yuasa (1922). Typically, each segment of the body has a large supraspiracular dark brown spot and two smaller subsiracular dark brown spots (fig. 17) as well as a dark spot between the prolegs on each abdominal segment. The head is black, and the apex of the tenth tergum is dark brown.

The supraspiracular spots are variable in size and may coalesce in some specimens to form a nearly solid, broad dorsal stripe.

Host and Biology.—Larvae feed on various species of birch including *Betula papyrifera* Marsh. (Wong, 1954; Raizenne, 1957), *B. lutea* Michx. (Raizenne, 1957), and *Betula lenta* L., *B. nigra* L., and *B. populifolia* Marsh. according to the host labels on specimens.

Wong (1954) studied this species in Manitoba and Saskatchewan. He noted that the larvae are gregarious and feed on the edge of the leaf and are found in early June and in September. There is one generation a year or a "second or partial generation." In Ontario, larvae were observed in late June and early September by Raizenne (1957). Cocoons were spun in early July and adults were found in early August.

Many specimens associated with Hopkins' numbers were reared from various species of birch in Connecticut. All were laboratory rearings. In most cases larvae were collected in late July through the middle of August and brought into the laboratory where adults emerged during September of the same year. In one rearing, larvae were collected in July and adults emerged the first part of August of the same year, and, in another rearing, larvae were collected the first of October and adults emerged during May of the following year. From those larvae collected in August, most of the adults appeared during the same year, but some did not appear until May of the following year. According to these data, there are either two generations a year or part of the second brood may remain in a cocoon in the soil, not emerging until the following year. A change of host plants was attempted in one experiment; larvae collected from white birch were transferred to black birch in the laboratory. The larvae apparently fed, but, within 10 days, all the larvae died.

Discussion.—This is the most commonly encountered species in this genus and is distinguished from the other species of *Croesus* by the dull and roughened mesopleuron and by the slight lobe at the apex of the hindbasitarsus. The black abdomen of the female will separate *latitarsus* from *varus*, and the red-banded abdomen of the male will separate it from *castaneae*. Annuli 2 to 9 of the lancet of *latitarsus* are nearly straight, as opposed the distinctly curved annuli of the lancet of *curvarius* and *varus*.

Croesus varus (Villaret)

Nematus varus Villaret, 1832, Soc. Ent. France Ann. 1:306; Dalla Torre, 1894, Catalogus Hymenopterum, Vol. I., p. 268, lists numerous references to this species in European literature prior to 1894.

Croesus varus: Kirby, 1882, List Hym. Brit. Mus., p. 102; Konow, 1905, Genera Insectorum, fasc. 29, p. 61; van Rossum, 1906, Ent. Bericht. 32:141; Buckle, 1930, Can. Ent. 62:21; Ross, 1951, U.S. Dept. Agr., Agr. Monog. 2, p. 42; Lorenz and Kraus, 1957, Die Larvalsystematik der Blattwespen, p. 219; Benson,

1958, Handbooks for Identification of British Insects, Vol. 6, pt. 2(c), p. 211; Benson, 1963, Ent. Tidskr. 84:26.

Female.—Length, 9.0 mm. Antenna and head black; clypeus, labrum, and mouthparts whitish. Thorax black with posterior margin of pronotum and tegula light orange. Front and middle legs with each coxa black, trochanter, tibia, and tarsus whitish, and femur orange; hindlegs with basal third of coxa black, apical two-thirds whitish, trochanter whitish, femur orange, with black at extreme tip, basal half of tibia white, apical half black, tarsus black. Abdomen black with segments 3 to 6 orange. Wings uniformly, very lightly infuscated.

Postocellar area slightly less than two times broader than long. Mesopleuron shiny, with well-spaced punctures; mesosternum shiny with fewer punctures than mesopleuron. Hindleg similar to that of *curvarius* (fig. 2). Lancet with 13 segments, annuli 2 to 8 with lateral armature and each curved backward ventrally; central and apical serrulae moderately deep, each with no anterior and 4 or 5 coarse posterior subbasal teeth (fig. 6).

Male.—Unknown in North America, and I have not seen specimens. According to Benson (1958) very rare but similar in color and structure to the female. The penis valve is illustrated by Benson (1958, fig. 653).

Type.—Not examined and location unknown. The application of this name is based on Benson (1958) and European specimens in the U.S. National Museum identified by Benson.

Distribution.—Palearctic, from Europe to Siberia; eastern Canada. QUEBEC: Montreal, 8-VIII-26, J. W. Buckle (1 ♀, in the Lyman Entomological Museum, McDonald College, Quebec). NOVA SCOTIA: specimen not seen, recorded by Kirby, (1882).

Host.—In Europe, the larva feeds on *Alnus* (Benson, 1958).

Larva.—Not examined, but described by Lorenz and Kraus (1957). The larvae apparently has one large supraspiracular spot and two small subspiracular black spots on each segment of the body, similar to the larva of *latitarsus*; however, the head is reddish-brown or reddish-yellow rather than black.

Discussion.—Kirby (1882) first recorded this species from a specimen that he had from North America, and Buckle (1930) later reported it from a specimen he collected in Montreal. The female Buckle collected is the only North American specimen I have seen.

The female is readily separated from other North American species of *Croesus* by the red-banded abdomen and orange femora. The lancet is also distinctive in that annuli 2 to 7 are markedly curved backward at their bases.

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